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WO 01/68780 A2

(54) Title: **POWDER COATING COMPOSITION**

(57) Abstract: Powder coating compositions comprising a blend of polyoxymethylene resin and an adhesion promoter for promoting adhesion of the composition to a substrate are described.

Title

POWDER COATING COMPOSITION

5 This application claims the benefit of the filing date of
U.S. Provisional Application No. 60/188,776, filed March 13, 2000.

Background of the Invention

 The present invention relates to powder coating
10 compositions, and more particularly to compositions containing
polyoxymethylene resins and adhesion promoters which
demonstrate improved adhesion to substrates. Parts coated with
such compositions have utility in many areas, including in the
automotive industry, industrial equipment, garment clips and the
15 like.

 Compositions containing polyoxymethylene resins and
various additives to improve toughness or impact strength are
known. These additives include thermoplastic polyurethanes,
20 polyolefins, and polyphenols. C.f. US Patent Nos. 4,804,716,
5,286,807 and 5,817,723. In addition, homogenous compositions
containing urethanes and polyoxymethylene (polyacetal) resins are
known for forming a printing member in the field of intaglio
printing (c.f. US Patent No. 4,388,865). A need remains, however,
25 to find an additive that will improve the adhesion of a
polyoxymethylene resin to a substrate.

Detailed Description

 It has been found that the adhesion of a
30 polyoxymethylene resin to a substrate can be improved
significantly by applying it as a powder coating composition

containing an adhesion promoter. In particular, it has been found that a powder coating composition comprising a blend of polyoxymethylene resin and an adhesion promoter for promoting adhesion of the composition to a substrate, wherein the adhesion

5 promoter is selected from at least one of the following:

(a) an ethylene co-, ter- or interpolymer which comprises (i) at least 50% by weight of ethylene, (ii) 1-35% by weight of an acid-containing unsaturated mono-carboxylic acid, and (iii) 0-49% by weight of a moiety selected from a at least one of alkyl acrylate, alkyl methacrylate, vinyl ether, carbon monoxide and sulfur dioxide, and further wherein the acid groups are neutralized from 0-100% by a metal ion;

10

(b) a copolymer of at least 50% by weight ethylene and 0.5-15% by weight of at least one reactive moiety selected from the group consisting of (i) unsaturated epoxides of 4-11 carbon atoms; (ii) unsaturated isocyanates of 2-11 carbon atoms; (iii) an aziridine; (iv) a silane; (v) an alkylating agent; and (vi) oxazoline.

15

(c) a thermoplastic polyurethane;

20

(d) a polyphenol;

(e) an adduct of (i) maleic anhydride, and (ii) a copolymer of ethylene, at least one C₃ to C₆ alpha-olefin, and at least one non-conjugated diene;

25

(f) an acrylic-modified elastomer-based polymer wherein the elastomeric portion is polymerized from a monomer mixture containing at least 50% by weight of at least one C₁ to C₁₅ alkyl acrylate, 0-5% by weight of at least one graft linking monomer, 0-5% by weight of a crosslinking monomer, and the balance to 100% by weight of at least one other

30

polymerizable ethylenically-unsaturated monomer;

(g) a thermoplastic elastomer selected from the group consisting of a co(polyether/ester), a co(polyester/ester) and a co(polyether/amide); and

(h) a styrene/diene block copolymer;

5 provides a particularly durable coating on a substrate. As a result, further included within the invention are a method of improving the adhesion of a polyoxymethylene resin to a substrate by the admixture with it of an adhesion promoter as described above to form a powder coating composition, and a coated article
10 coated with a powder coating composition as described above.

Where adhesion promoters (a)-(c) and (e)-(h) are employed, the blends are generally two-phase, non-homogeneous. Certain polyphenol (d) adhesion promoters, however, tend to be
15 soluble, leading to single phase, homogeneous blends.

Polyoxymethylene resins are known. They may be generally described as homopolymers of formaldehyde or a cyclic oligomer of formaldehyde, the terminal groups of which are end
20 capped by esterification or etherification, and copolymers of formaldehyde or of a cyclic oligomer of formaldehyde and other monomers that yield oxyalkylene groups with at least two adjacent carbon atoms in the main chain, the terminal groups of which copolymers can be hydroxyl terminated or can be end capped by
25 esterification or etherification. Suitable polyoxymethylene resins are available from DuPont under the tradename Delrin®. They may contain various known additives such as those previously mentioned to improve properties such as toughness or impact strength, stability, oxidation resistance.

Ethylene copolymers (a) useful in the present invention comprise (i) at least 50% by weight of ethylene, (ii) 1-35% by weight of an acid-containing unsaturated mono-carboxylic acid, and (iii) 0-49% by weight of a moiety selected from at least one of alkyl
5 acrylate, alkyl methacrylate, vinyl ether, carbon monoxide and sulfur dioxide, and further wherein the acid groups are neutralized from 0-100% by a metal ion.

Preferred ethylene copolymers comprise (i) at least 60% by weight of ethylene, (ii) 5-15% by weight of acrylic acid or
10 methacrylic acid, and (iii) 0-25% by weight of a moiety selected from at least one of methyl acrylate, iso-butyl acrylate and n-butyl acrylate, and further wherein the acid groups are neutralized from 0-70%, preferably from 30-70%, by at least one metal ion selected from lithium, potassium, sodium, zinc, magnesium, aluminium,
15 and calcium.

Suitable preferred ethylene copolymers include ethylene/acrylic acid, ethylene/methacrylic acid, ethylene/acrylic acid/n-butyl acrylate, ethylene/methacrylic acid/n-butyl acrylate, ethylene/methacrylic acid/iso-butyl acrylate, ethylene/acrylic acid/iso-butyl
20 acrylate, ethylene/methacrylic acid/n-butyl methacrylate, ethylene/acrylic acid/methyl methacrylate, ethylene/acrylic acid/ethyl vinyl ether, ethylene/methacrylic acid/butyl vinyl ether, ethylene/acrylic acid/methyl acrylate, ethylene/methacrylic acid/methyl
25 methacrylate, ethylene/acrylic acid/n-butyl methacrylate, ethylene/methacrylic acid/ethyl vinyl ether and ethylene/acrylic acid/butyl vinyl ether. The most preferred ethylene copolymers for use in the compositions of the present invention are ethylene/methacrylic acid and ethylene/acrylic acid copolymers,

and ethylene/methacrylic acid/n-butyl acrylate and ethylene/methacrylic acid/ methylacrylate terpolymers.

Copolymers (b) useful in the compositions of the inventions are copolymers prepared from ethylene copolymerized
5 with one or more reactive moieties selected from (i) unsaturated epoxides of 4-11 carbon atoms, such as glycidyl acrylate, glycidyl methacrylate, allyl glycidyl ether, vinyl glycidyl ether, and glycidyl itaconate; (ii) unsaturated isocyanates of 2-11 carbon atoms, such as vinyl isocyanate or isocyanato-ethyl methylacrylate; (iii) an
10 aziridine; (iv) silanes such as alkoxy or alkyl silanes wherein the alkoxy or alkyl group contains from 1-12 carbon atoms; (v) alkylating agents such as alkyl halides or alkyl alpha-halo ketones or aldehydes; and (vi) oxazoline. In particular, the copolymer may comprise at least 50% by weight ethylene, 0.5-15% by weight of at
15 least one of the reactive moieties described above, and 0-49% by weight of a moiety selected from at least one of an alkyl acrylate, an alkyl methacrylate and vinyl ether (wherein the alkyl and/or ether groups contain 1-12 carbon atoms); carbon monoxide; and sulfur dioxide.

20 Preferred copolymers for use in copolymers (b) include ethylene/glycidyl acrylate, ethylene/n-butyl acrylate/glycidyl acrylate, ethylene/ methylacrylate/glycidyl acrylate, ethylene/glycidyl methacrylate, ethylene/n-butyl acrylate/glycidyl methacrylate and ethylene/methylacrylate/glycidyl methacrylate
25 copolymers. The most preferred copolymers are derived from ethylene/n-butyl acrylate/glycidyl methacrylate and ethylene/glycidyl methacrylate.

An especially preferred copolymer comprises at least 55% by weight ethylene, 1-10% by weight of an unsaturated

epoxide of 4-11 carbon atoms, and 0-35% by weight of at least one alkyl acrylate or alkyl methacrylate, or mixtures thereof where the alkyl groups contain 1-8 carbon atoms. Preferred unsaturated epoxides are glycidyl methacrylate and glycidyl acrylate, which are
5 present in the copolymer at a level of 1-7% by weight. Preferably, ethylene content is greater than 60% by weight, and the third moiety is selected from methyl acrylate, iso-butyl acrylate and n-butyl acrylate.

Useful thermoplastic polyurethanes (c) and their
10 preparation are described in U.S. Patent 5,286,807. They can be selected from those commercially available, or can be made by processes known in the art. [See, for example, Rubber Technology, 2nd edition, edited by Maurice Morton (1973), Chapter 17, Urethane Elastomers, D.A. Meyer, especially pp. 453-456.]
15 Polyurethanes are derived from the reaction of polyester or polyether diols with diisocyanates, and optionally also from the further reaction of such components with chain-extending agents such as low molecular weight polyols, preferably diols, or with diamines to form urea linkages. Polyurethane elastomers are
20 generally composed of soft segments, for example polyether or polyester polyols, and hard segments, usually derived from the reaction of the low molecular weight diols and diisocyanates. Polyurethane elastomers with no hard segments can be used to prepare compositions of the present invention. However, those
25 most useful in the compositions of the present invention will contain both soft and hard segments.

Useful polyphenols (d) are compounds having more than one phenolic group on the molecule such as a novolacs, resoles, polyvinyl phenols, phenolated resins, a bisphenol or a
30 biphenol.

Useful adducts of maleic anhydride with an ethylene copolymer (e) and their preparation are described in U.S. Patent 3,884,887 and U.S. Re. 31,680. These copolymers of ethylene are typically elastomeric and are composed of ethylene, at least one C₃ to C₆ alpha-olefin, preferably propylene, and at least one nonconjugated diene, preferably 1,4 hexadiene, alone or with 2,5-norbornadiene. The maleic anhydride content of the adduct is 0.5 to 9% by weight, preferably 1-4% by weight; and the adduct has an inherent viscosity of at least 1, preferably at least 1.5, as measured on 0.1 gram of adduct copolymer dissolved in 100 milliliters of perchloroethylene at 30°C.

Useful acrylic-modified elastomeric-based polymers (f) and their preparation are described in U.S. Patent 4,167,505. Those described in column 4, lines 39-55 are most preferred. The acrylic-elastomer polymers have an elastomeric portion which is polymerized from a monomer mixture containing at least 50% by weight of at least one C₁ to C₁₅ alkyl acrylate, 0-5% by weight of at least one graftlinking monomer, 0-5% by weight of a crosslinking monomer, and the balance to 100% by weight of at least one other polymerizable ethylenically unsaturated monomer. Suitable graftlinking monomers and crosslinking monomers are described in column 3, lines 34-48 of U.S. Patent 4,167,505. Exemplary graftlinking monomers include allyl acrylate, diallyl maleate and allyl acid maleate. Exemplary crosslinking monomers include butylene diacrylate and divinyl benzene.

Preferred polymers are an elastomeric-based acrylic core/shell polymer having:

(i) 70-80 parts by weight of a first acrylic elastomeric stage comprising a polymer polymerized from a monomer

mixture comprising 79-99.5 parts by weight n-butyl acrylate,
0-10 parts by weight of at least one polymerizable
monoethylenically or conjugated diethylenically unsaturated
monomer, 0.1-5 parts by weight 1,4-butylene glycol
5 diacrylate and 0.1-5 parts by weight diallyl maleate; and

(ii) 20-30 parts by weight hard shell final stage
polymer polymerized in the presence of said first elastomeric
stage from a monomer mixture comprising about 80-100
parts by weight methyl methacrylate, 0-20 parts by weight of
10 another monoethylenically unsaturated monomer, and 0-5
parts by weight monoethylenically unsaturated carboxylic
acid.

Thermoplastic elastomers (g) useful in the
compositions of this invention include a co(polyether/ester), a
15 co(polyester/ester) and a co(polyether/amide).

Co(polyether/ester)s are preferred and are described in
U.S. Patent 4,221,703. Preferred co(polyether/ester)s are
prepared from dimethyl terephthalate, 1,4-butanediol, and poly
(tetramethylene oxide) glycol having a molecular weight of about
20 600-2000, or poly (ethylene oxide) glycol having a molecular weight
of about 600-1500. Optionally, up to about 30 mole % and
preferably 5-20 mole % of the dimethyl terephthalate in these
polymers can be replaced by dimethyl phthalate or dimethyl
isophthalate. Other preferred co(polyether/ester)s are those
25 prepared from dimethyl terephthalate, 1,4-butanediol, and
poly(propylene oxide) glycol having a molecular weight of about
600-1600. Up to 30 mole % and preferably 10-25 mole % of the
dimethyl terephthalate can be replaced with dimethyl isophthalate,
or butanediol can be replaced with neopentyl glycol to the extent

that about 30 mole % and preferably 10-25 mole % of the short chain ester units are derived from neopentyl glycol in the poly(propylene oxide) glycol polymers.

Co(polyester/ester) elastomers are described in EP-
5 013461. Preferred co(polyester/ester)s are prepared from polybutylene adipate, polyethylene adipate, polybutylene terephthalate and/or polycaprolactone of various molecular weights, and aliphatic or aromatic diisocyanates, particularly toluene diisocyanate, having a molecular weight in the range of
10 500-5000.

Co(polyether/amide)s include both the statistical co(polyether/amide)s, which have random chain lengths of their different monomeric constituents, and sequential co(polyether/amide)s, which comprise recurring polyether and
15 polyamide sequences constituted by block segments of varying chain lengths of the different constituents thereof, *e.g.* polyamide blocks and polyether blocks. Sequential co(polyether/amide)s result from the copolycondensation of polyamide sequences having reactive end groups with polyether sequences having reactive end
20 groups, such as, for example: (i) polyamide sequences having terminal amino groups at each end of the polymer chain with polyoxyalkylene sequences having terminal carboxylic acid groups at each end of the polyether chain; (ii) polyamide sequences having terminal carboxylic acid groups at each end of the
25 polyamide chain with polyoxyalkylene sequences having terminal amino groups at each end of the polyether chain, prepared by cyanoethylation and hydrogenation of aliphatic alpha, omega-dihydroxy polyoxyalkylenes, designated polyetherdiols; and (iii) polyamide sequences having terminal carboxylic acid groups at
30 each end of the polyamide chain with such polyetherdiols, the

resulting polyetheramides being co(polyether/ester/amide)s. The composition and preparation of co(polyether/ester/amide)s is described in French Patents Nos. 74.18913 and 77.26678, and in U.S. Pat. Nos. 4,331,786 and 4,332,920.

5 Useful styrene/diene block copolymers (h) are described in U.S. Patent 4,548,988. In general, these copolymers have 3 or more sequences of the S-(D-S)_n structure where n is a whole number, S is a polystyrene block, D is a hydrogenated isoprenic block or hydrogenated butadienic block, with a content in
10 styrene less than 50% by weight. Optionally, these block copolymers can be grafted with maleic anhydride so as to form adducts which contain 0.1 to 10% by weight, preferably 0.2 to 5%, of maleic anhydride (see U.S. Patent 4,578,429).

15 The amount of the adhesion promoter in the powder coating compositions of the present invention can vary from about 0.5% to 80% weight percent, preferably from about 1% to 45% weight percent.

20 Typical additives which may be used in the powder coating compositions of the present invention include a stabilizer such as polyamide, melamine, an antioxidant, a formaldehyde trap, a heat stabilizer, UV absorbers, lubricants, coloring pigments, a reinforcement and/or filler, tribological property enhancers,
25 plasticizers or the like.

 The particle size of the powders employed in the present coating compositions will typically have a median size less than 150μ, for example ranging from 20 to 80μ for use in
30 electrostatic coating; and a median size of about 150μ, for example

ranging from 20 to 300 μ for use in fluidized bed coating. The compositions may be prepared in general by mixing the polyoxymethylene resin with the adhesion promoter and melt blending in a twin screw extruder. The extrudate is then cooled
5 and cut into granules. Thereafter the granules are ground to the desired size. Alternatively, the polyoxymethylene resin and adhesion promoter may be formed into granules and ground separately, and then mixed.

10 The processing conditions used in the preparation of the powder coating compositions of the present invention will be selected as a function of the composition to be mixed. The adhesion promoter should be intimately mixed in the polyoxymethylene resin. Any intensive mixing device capable of
15 developing high shear at temperatures above the melting points of the ingredients can be used to disperse the adhesion promoter in the polyoxymethylene resin. Examples include rubber mills, internal mixers such as "Banbury" and "Brabender" mixers, single or multiblade internal mixers with a cavity heated externally or by
20 friction, "Ko-kneaders", multibarrel mixers such as "Farrel Continuous Mixers", and extruders, both single screw and twin screw, both corotating and counter rotating. In general the ingredients will be fed to a twin screw extruder and compounded at a melt temperature of 220°C. The strand is solidified and
25 granulated. The granules, typically 1-5mm in size, are then ground to the required size using a mill, possibly with cooling or cryogenic cooling.

 Application of the powder coating compositions of the
30 present invention to substrates can take place by any conventional method, such as fluidized bed coating and electrostatic coating.

For example for fluidized bed coating, the substrate is heated above the melt temperature of acetal polymer, *e.g.* 250 °C, then dipped into the fluidized bed. The resulting coated substrate is allowed to cool. The surface can be improved by a subsequent
5 annealing or quenching step. Typically, a coating having a thickness of about 5-300 μ of resin is deposited.

For electrostatic coating, the powder is applied to a cold substrate surface using an electrostatic gun. When enough
10 resin adheres to a surface the coated piece is heated above the melting point of the acetal polymer, *e.g.* 250 °C. The surface can be improved by a subsequent annealing or quenching step. Typically, a coating having a thickness of about 5-300 μ of resin is deposited.

15

Substrates can be polymeric materials having melting points greater than those of the powder coating composition, and metals. Metals include steel, tinplate, galvanized steel, brass and aluminum. Typical end uses for metal substrates coated with the
20 powder compositions of the present invention include guides, clips in lingerie, an automobile part such as automotive door checks, rails in industrial equipment such as sliding doors and conveyor belts.

25

Examples

Example 1

Delrin® 100 polyoxymethylene resin ("POM", available from E.I. du Pont de Nemours and Company) is ground to a
30 median particle size of 80 μ . It is then blended with Abcite® 1060 ethylene/methacrylic acid copolymer that has been neutralized

with zinc ions and has a MFI (ASTM D1238) of 14 g/10 min ("EMA", available from E.I. du Pont de Nemours and Company) in a weight ratio of POM/EMA of 90/10.

- 5 A 4 mm thick steel sheet is heated to 250°C and then dipped into a fluidized bed of the powder composition for 3 seconds and allowed to cool to room temperature. Two cuts through the resin coating are made with a knife blade 1 cm apart. The coating cannot be peeled from the metal.

10

Comparative Example

- Delrin® 900P polyoxymethylene resin (available from E.I. du Pont de Nemours and Company) is ground to a median particle size of 200 μ . A 4 mm thick steel sheet is heated to 250°C
- 15 and then dipped into a fluidized bed of the polyoxymethylene resin for 3 seconds and allowed to cool to room temperature. Two cuts through the resin coating are made with a knife blade 1 cm apart. The coating peels from the metal without resistance.

Claims

1. A powder coating composition comprising a blend
of polyoxymethylene resin and an adhesion promoter for promoting
5 adhesion of the composition to a substrate, wherein the adhesion
promoter is selected from at least one of the following:

- (a) an ethylene co-, ter- or interpolymer which
comprises (i) at least 50% by weight of ethylene, (ii) 1-35% by
weight of an acid-containing unsaturated mono-carboxylic
10 acid, and (iii) 0-49% by weight of a moiety selected from a at
least one of alkyl acrylate, alkyl methacrylate, vinyl ether,
carbon monoxide and sulfur dioxide, and further wherein the
acid groups are neutralized from 0-100% by a metal ion;
- (b) a copolymer of at least 50% by weight ethylene and
15 0.5-15% by weight of at least one reactive moiety selected
from the group consisting of (i) unsaturated epoxides of 4-11
carbon atoms; (ii) unsaturated isocyanates of 2-11 carbon
atoms; (iii) an aziridine; (iv) a silane; (v) an alkylating
agent; and (vi) oxazoline;
- 20 (c) a thermoplastic polyurethane;
- (d) a polyphenol;
- (e) an adduct of (i) maleic anhydride, and (ii) a
copolymer of ethylene, at least one C₃ to C₆ alpha-olefin, and
at least one non-conjugated diene;
- 25 (f) an acrylic-modified elastomer-based polymer wherein the
elastomeric portion is polymerized from a monomer mixture
containing at least 50% by weight of at least one C₁ to C₁₅
alkyl acrylate, 0-5% by weight of at least one graft linking
monomer, 0-5% by weight of a crosslinking monomer, and
30 the balance to 100% by weight of at least one other
polymerizable ethylenically-unsaturated monomer;

(g) a thermoplastic elastomer selected from the group consisting of a co(polyether/ester), a co(polyester/ester) and a co(polyether/amide); and

(h) a styrene/diene block copolymer.

5

2. A powder coating composition according to Claim 1 wherein the polyoxymethylene resin is a homopolymer of formaldehyde or a cyclic oligomer of formaldehyde, or a copolymer of formaldehyde or a cyclic oligomer of formaldehyde and one or
10 more other monomers that yield oxyalkylene groups with at least two adjacent carbon atoms in the main polymer chain.

3. A powder coating composition according to Claim 1 wherein the adhesion promoter is at least one of (a)-(c) and (e)-(h),
15 and the blend is two-phase, non-homogeneous.

4. A powder coating composition according to Claim 1 wherein the adhesion promoter is a polyphenol (d), and the blend is single phase, homogeneous.

20

5. A powder coating composition according to Claim 1 wherein the adhesion promoter is (a) an ethylene co-, ter- or interpolymer which comprises (i) at least 50% by weight of ethylene, (ii) 1-35% by weight of an acid-containing unsaturated
25 mono-carboxylic acid, and (iii) 0-49% by weight of a moiety selected from at least one of alkyl acrylate, alkyl methacrylate, vinyl ether, carbon monoxide and sulfur dioxide, and further wherein the acid groups are neutralized from 0-100% by a metal ion.

30

6. A powder coating composition according to Claim 1 wherein the adhesion promoter is (b) a copolymer of at least 50% by weight ethylene and 0.5-15% by weight of at least one reactive moiety selected from the group consisting of (i) unsaturated
5 epoxides of 4-11 carbon atoms; (ii) unsaturated isocyanates of 2-11 carbon atoms; (iii) an aziridine; (iv) a silane; (v) an alkylating agent; and (vi) oxazoline.

7. A powder coating composition according to Claim 1
10 wherein the adhesion promoter is (c) a thermoplastic polyurethane.

8. A powder coating composition according to Claim 1 wherein the adhesion promoter is (d) a polyphenol.

15 9. A powder coating composition according to Claim 1 wherein the adhesion promoter is (e) an adduct of (i) maleic anhydride, and (ii) a copolymer of ethylene, at least one C₃ to C₆ alpha-olefin, and at least one non-conjugated diene.

20 10. A powder coating composition according to Claim 1 wherein the adhesion promoter is (f) an acrylic-modified elastomer-based polymer wherein the elastomeric portion is polymerized from a monomer mixture containing at least 50% by weight of at least one C₁ to C₁₅ alkyl acrylate, 0-5% by weight of at least one graft
25 linking monomer, 0-5% by weight of a crosslinking monomer, and the balance to 100% by weight of at least one other polymerizable ethylenically-unsaturated monomer.

11. A powder coating composition according to Claim 1 wherein the adhesion promoter is (g) a thermoplastic elastomer selected from the group consisting of a co(polyether/ester), a co(polyester/ester) and a co(polyether/amide).

5

12. A powder coating composition according to Claim 1 wherein the adhesion promoter is (h) a styrene/diene block copolymer.

10

13. A powder coating composition according to Claim 1 wherein the content of the adhesion promoter is in the amount of about 1% to 45% by weight of the composition.

14. A coated article obtained by applying a powder
15 coating composition according to Claim 1 to a substrate.

15. A coated article according to Claim 14 wherein the substrate is metal.

20 16. A coated article according to Claim 14 which is an automobile part.

17. A method of improving the adhesion of a polyoxymethylene resin to a substrate comprising preparing a
25 powder coating composition that is a blend of the polyoxymethylene resin and an adhesion promoter according to Claim 1, and applying the powder coating composition to the substrate.

30 18. A method according to Claim 17 wherein the substrate is metal.

19. A method according to Claim 17 wherein the powder coating composition is applied by electrostatic spray or by a fluidized bed.

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WO 01/68780 A3

(54) Title: POWDER COATING COMPOSITION COMPRISING A POLYOXYMETHYLENE RESIN

(57) Abstract: Powder coating compositions comprising a blend of polyoxymethylene resin and an adhesion promoter for promoting adhesion of the composition to a substrate are described.

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

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IPC 7 C09D C08L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 071 011 A (CROSFIELD ELECTRONICS LTD) 16 September 1981 (1981-09-16) page 3, line 80 - line 91 ---	1,2,7, 17-19
X	US 5 817 723 A (KOBAYASHI TOSHIKAZU ET AL) 6 October 1998 (1998-10-06) cited in the application claim 1 ---	1,4,8
X	WO 99 35191 A (DU PONT) 15 July 1999 (1999-07-15) page 4, line 17 -page 5, line 21 ---	1,5,6
X	US 5 177 056 A (HILTI BRUNO ET AL) 5 January 1993 (1993-01-05) column 3, line 20 - line 24 column 4, line 11 column 13, line 7 - line 9 -----	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Information on patent family members

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